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APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE: POWERTRAIN MOUNT HAVING CAPACITIVE DISPLACEMENT SENSOR

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POWERTRAIN MOUNT HAVING CAPACITIVE DISPLACEMENT SENSOR

TECHNICAL FIELD OF THE INVENTION

The present invention relates to powertrain mounts for motor vehicles, and more particularly to a powertrain mount having a capacitive displacement sensor.

BACKGROUND OF THE INVENTION

It is desirable to provide modern vehicles with improved operating smoothness by damping and/or isolating powertrain vibrations of the vehicle. A variety of mount assemblies are presently available to inhibit such engine and transmission vibrations. Many of these mount assemblies combine the advantageous properties of elastomeric materials with hydraulic fluids. A hydraulic mount assembly of this type typically includes a reinforced, hollow rubber body that is closed by a resilient diaphragm so as to form a cavity. This cavity is separated into two chambers by a plate. The chambers are in fluid communication through a relatively large central orifice in the plate. The first or primary chamber is formed between the partition plate and the body. The secondary chamber is formed between the plate and the diaphragm.

Active vibration control has more recently become known in the art. The three basic components of an active vibration isolation system are a motion sensor (e.g. a motion transducer), a processor and a control device. The sensor responds to vibratory motion by converting the vibratory motion into an electrical output signal that is functionally related to a parameter (e.g. displacement, velocity or acceleration) of the experienced motion. An accelerometer, for example, is a type of sensor wherein the output is a function of the acceleration input; the output is typically expressed in terms

of voltage per unit of acceleration. The most common processor is a microprocessor that combines A/D conversion and a control signal derivation section. The control device can be any one of a number of electrically controllable devices designed to control damping in the hydraulic mount.

SUMMARY OF THE INVENTION

The present invention is a mount for a powertrain component of a motor vehicle. The mount comprises first and second plates, and a controller. The first plate is connected to one of the powertrain component or a frame of the motor vehicle. The second plate is connected to the other of the powertrain component or the frame of the motor vehicle. The controller adjusts the damping characteristics of the mount as a function of the capacitance between the first plate and the second plate.

Accordingly, it is an object of the present invention to provide a mount of the type described above which does not restrict movement of the powertrain mount along any of the x-, y-, or z-axes.

Another object of the present invention is to provide a mount of the type described above which determines the vertical displacement of the mount independent of displacement along any other axis.

The foregoing and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiments, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention rather than limiting, the scope of the invention being defined by the appended claims and equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic cross-sectional view of a powertrain mount according to the present invention in a first position; and

FIG. 2 is a schematic cross-sectional view of the powertrain mount in a second position.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

FIG. 1 shows a mount assembly **10** which is attached to an engine **12** or transmission by an electrically insulative fastener **14** such as a stud or the like. The mount assembly **10** is similarly attached to a vehicle frame **16** by an electrically insulative fastener **15** such that the mount is interposed between the engine **12** and the frame member **16**. The mount **10** includes a top metal insert or plate **18** and a metal orifice plate **20**. A hollow, flexible body **22** generally interconnects the insert **18** and the orifice plate **20**. The body **22** can be formed of an elastomeric material, such as natural or synthetic rubber. A diaphragm **24** is attached to the underside of the orifice plate **20** and, together with the body **22**, generally defines a chamber **25** for any suitable hydraulic fluid.

A capacitance-to-voltage device **26** is electrically connected to the insert **18** and to the orifice plate **20**. In a preferred embodiment, the capacitance-to-voltage device **26** continually applies a small voltage through wires **28** and **30** to positively charge the insert **18** and to negatively charge the orifice plate **20**. At the same time, the capacitance-to-voltage device **26** measures the capacitance across the plates **18** and **20**, and communicates this information to a system controller **32**. Because the plates **18** and **20** essentially form an RC circuit with the capacitance-to-voltage device **26**, the plates **18** and **20** can alternatively be periodically charged, and their rate of discharge can be compared with a known curve. Any deviation from this expected curve can then be easily calculated by the controller **32**, and the change in capacitance interpreted as

vertical displacement of the mount. It should be appreciated that either a direct current or an alternating current can be applied in the present invention.

The controller **32**, in turn, is electrically connected to a variable orifice **34** in the orifice plate **20**. It should be understood, of course, that the capacitance-to-voltage device can be incorporated, physically or electronically, into the controller **32**. Similarly, while the plates 18 and 20 are preferably electrically isolated from ground, one of the plates may be grounded and separate compensating circuitry provided.

During vehicle operation, engine and transmission vibrations or road impacts subject the insert **18** and the orifice plate **20** to relative displacement. **FIG. 2** shows an example of such a displacement. When the insert **18** is vertically displaced relative to the orifice plate **20**, the capacitance-to-voltage device **26** measures a change in capacitance between them and communicates this information to the controller **32**. In a preferred embodiment, the measured capacitance is inversely proportional to the vertical or x-axis distance between the plates **18** and **20**. In response to this the signal from the capacitance-to-voltage device **26**, the controller **32** outputs an electrical signal to the variable orifice **34** suitable to alter the damping characteristics of the mount.

While the embodiment of the invention disclosed herein is presently considered to be preferred, various changes and modifications can be made without departing from the spirit and scope of the invention. The scope of the invention is indicated in the appended claims, and all changes that come within the meaning and range of equivalents are intended to be embraced therein.